

THE MARKET FOR PHYSICIANS' SERVICES: THEORETICAL IMPLICATIONS AND AN
EMPIRICAL TEST OF THE TARGET INCOME HYPOTHESIS

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ABSTRACT

This paper provides an analysis of market equilibria in situations in which physicians may have the ability to significantly affect the demand for their services, and in which those physicians attempt to earn a target level of income, rather than to maximize income.

It is shown that the empirical result most frequently cited as evidence for the supply induced demand hypothesis can not be predicted by the supply induced demand model. Further, the paper demonstrates that ordinary supply and demand analysis is not appropriate if physicians induce demand. In such a case, there can exist no systematic relationship between price and any exogenous variables.

An empirical model based upon the implications of the theoretical analysis is proposed and estimated. The parameter estimates may be employed to judge the practical importance of the supply induced demand phenomenon.

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THE TARGET INCOME HYPOTHESIS

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Over the period 1965 to 1977, expenditure upon health care in the United States increased from \$181 per capita to \$697 per capita.¹ The share of GNP composed of health care expenditures grew from 5.9% in 1965 to 8.8% in 1977. Over this same period, the number of physicians in the U.S. increased from 153 physicians per 100,000 population to 194 physicians per 100,000. Such startling figures have generated much interest in the economics of health care, with special concern about physician behavior and its effects upon health care costs.

The frequent empirical finding of a positive partial correlation between physicians' fees or earnings and the number of physicians per capita have led many observers to eschew standard supply and demand models in favor of models which allow physicians themselves to significantly affect the demand for their services.

An assumption that physicians influence demand can not by itself differentiate a model from standard microeconomic models. A profit maximizing doctor possessing (costless) demand shifting powers would shift demand to the greatest possible extent, and then choose price and quantity to maximize profits subject to that shifted demand function. Thus a demand shifting model can yield results which are qualitatively different from those predicted by a standard model only with a behavioral assumption other than profit maximization. The assumption of satisficing behavior on the part of physicians is a common substitute.

Numerous empirical findings have been cited as evidence of the validity of the satisficing-with-demand-shifting models. Much of this evidence, however, has been obtained as a by-product of estimates of the demand for physician services, rather than as the result of the estimation

of a supply-induced-demand-with-satisficing model. This lack of direct empirical evidence apparently stems from the lack of careful specification of the assumptions and theoretical implications of such a model.

It is the purpose of this paper to provide both a theoretical analysis of the implications of a supply-induced-demand-with-satisficing model and a direct empirical estimate of that model. It is not the purpose of this paper to advocate or condemn the assumptions behind such a model. The analysis accepts as given certain assumptions which, in the author's opinion, reasonably represent the underlying foundations of supply-induced demand models. The implications of these assumptions are analyzed, and an empirical model based upon these implications is estimated.

Among the surprising conclusions of the analysis is the fact that the empirical result most frequently cited as evidence for the supply induced demand hypothesis can not be predicted by that model. Therefore, this common empirical finding (or its opposite) offers no evidence for or against the supply induced demand hypothesis.

Further, the model, in conjunction with its parameter estimates, provides a method of estimating the likelihood that an increase in the number of physicians in any market would result in increased demand in that market. And finally, the model provides a framework for empirical analysis of the determinants of an individual physician's target level of income.

The remainder of the paper is divided into four sections. Section 1 provides a brief, non-exhaustive summary of empirical findings which have led researchers to entertain the supply shifting hypothesis. Section 2 suggests various possible sets of assumptions which can provide a logical foundation for a supply shifting and satisficing model, and analyzes the implications for market equilibrium of each set of assumptions.

Section 3 proposes an empirically testable model which is consistent with the implications derived in section 2. Finally, the results of the estimation of that model are presented in section 4.

1. Empirical Motivation for the Supply Induced Demand Hypothesis

In 1972, Victor Fuchs and Marcia Kramer published a study of physician utilization in the U.S. throughout the period 1948-1968. They reported that people who lived in states in which there were a large number of doctors relative to the population tended to purchase more physician services than their counterparts in states with relatively fewer doctors. This result was found even after accounting for price differentials. In a cross sectional analysis of physician utilization by states in 1966, the quantity of medical services consumed per capita was regressed upon average price, per capita income, and the number of physicians per capita. The coefficient of the physician per capita variable was positive and highly significant. Furthermore, the estimated elasticity of demand with respect to the number of physicians per capita, $+ .4$, was large relative to the elasticities of demand with respect to income and insurance. These results led Fuchs and Kramer to express the following warning:

Because physicians can and do determine the demand for their own services to a considerable extent, we should be wary of plans which assume that the cost of medical care would be reduced by increasing the supply of physicians.

In an article published in 1970, Joseph Newhouse analyzed the variance of the price per office visit charged by general practitioners across 18 SMSA's. After accounting for per capita income differentials, he found a partial correlation between price and the number of physicians per capita of $+ .55$.

While the thesis of the article was that a competitive supply-demand model did not adequately represent physician service markets, the author

noted that the data did not perfectly fit a monopolistic profit maximizing model either. He suggested that one possible explanation was that doctors satisfice, or set target levels of income:

As the number of physicians in an area increases, visits per physician will tend to fall. To achieve any given target income, each physician will have to charge higher fees.³

The validity of the supply induced demand model was strongly endorsed by Robert Evans in two separate papers. In the first, Evans et al. (1973) studied gross billings per physician in cities in British Columbia throughout 1969. At the time of the study, physicians' fees were set according to a standard province-wide fee schedule. Therefore, Evans et al. argued, in the absence of either demand creation by physicians, or permanent excess demand for physicians' services, an increase in the number of physicians per capita should lead to a decrease in the average workload of each physician. That is, the elasticity of gross billings per physician with respect to the number of physicians per capita should equal -1. Empirical estimates of the elasticity, however, fell in the vicinity of zero. Evans further estimated the elasticity of total per capita expenditure for physicians' services with respect to the number of physicians per capita as + .85.

In a second article, Evans (1974) proposed a model in which physicians are assumed to have rough targets of income and workload which are based upon their training, expectations, and previous experience. If income and workloads fall below target levels, demand generation takes place. If physicians feel overworked and underpaid, upward pressure on prices may develop. According to Evans, the implications of such a model would include upward pressure on price when supply increases, as well as relatively little response of income per physician. Furthermore, "the primary function of price is (in conjunction with workloads) to achieve

physician income targets."⁴

Fuchs (1976) estimated the demand for operations across geographic areas throughout the period 1963-1970. His results led him to conclude that: "Other things equal, a 10 percent higher surgeon/population ratio results in about a 3 percent increase in the number of operations and an increase in price."⁵ Fuchs noted that these results raise the troublesome question of why surgeons don't increase demand even more than they do. He suggested that one possible answer was that incomes and workloads were already satisfactory.

Other empirical studies⁶ have also found positive partial correlations between the number of physicians per capita and service demands, (May, 1975), or fees (L. F. Huang and Koropecy, 1973).⁷

Such empirical findings, although common, have not been universal. For example, Sloan (1976) and Steinwald and Sloan (1974) have found negative partial correlations between prices and physicians per capita.

2. Theoretical Implications of the Supplied Induced Demand and Target Income Hypotheses

The phenomena of "supply induced demand" and "target income pricing" will be initially analyzed in a supply and demand framework. Market equilibrium will be characterized first in the case in which physicians seek target levels of income, but can not induce demand, and then in the case in which physicians can induce demand in order to achieve their target incomes.

2A. Implications of the Target Income Hypothesis Without Demand Inducement.

Suppose that the economic decisions of each physician concerning inputs, output, and price are guided by the goal of earning a target level of income. Two alternative definitions of "income" appear plausible.

Conventional microeconomic theory of the firm would suggest that a physician's profit, or net income, is the relevant measure of "target." However, behavioral theories of the firm might suggest that revenue, or gross income, is the entity of concern to the physician.⁸ Since there is no apparent a priori reason to choose one definition over the other, both alternatives will be considered, with the latter definition employed first.

Let T_i represent the target level of gross income (revenue) chosen by the i^{th} physician. Then the supply schedule of the i^{th} physician simply represents all combinations of price and output⁹ that yield T_i dollars. Letting q_i represent the quantity of services which the i^{th} physician would be willing to supply at price P_i , this schedule can be represented mathematically as follows:

$$(1a) \quad P_i q_i = T_i$$

or

$$(1b) \quad P_i = \frac{T_i}{q_i}$$

Equation (1b) indicates that the individual physician's inverse supply function may be graphically represented as a rectangular hyperbola. That is, the physician's supply curve is everywhere downward sloping.

An aggregate, or market supply, may be derived from the individual physician supplies under an appropriate assumption about market behavior. Specifically, it is assumed that there exist enough reasonably well informed and mobile consumers that all doctors in a given market must charge approximately the same price per unit of service. With this assumption, it makes sense to define a market price, P , and a market quantity, Q , that would be supplied at that price. By equation (1):

$$(2a) \quad Q \equiv \sum_i q_i = \frac{1}{P} \sum_i T_i$$

or

$$(2b) \quad P = \frac{\sum_i T_i}{Q}$$

where the summation includes all physicians in the market. Thus, aggregate supply is also mathematically represented by a rectangular hyperbola.

Given aggregate supply, the market equilibrium can be derived graphically by superimposing the market supply and demand curves, as illustrated in figure 1. Since the supply curve has negative slope, problems of stability must be taken into account.

Assumption 1

It is assumed that market forces cause price to rise in response to excess demand, and to fall in response to excess supply.

Assumption 1 implies that the equilibrium designated by point B in figure 1 is unstable, since there will be excess demand at prices greater than P_B and excess supply at prices smaller than P_B . Assumption 1 further implies the following theorems.

Theorem 1

Let P^* represent an equilibrium price defined by the intersection of any downward sloping demand function and the downward sloping supply function implied from the target model, i.e., $PQ = T$. The price P^* represents a stable equilibrium only if demand is elastic at that price.

Proof:

Assumption 1 implies that P^* can represent a stable equilibrium only if the inverse supply function is more steeply sloped in the vicinity of P^* than the inverse demand function. This requires:

$$(3) \quad \left. \frac{dQ}{dP} \right|_S \frac{P^*}{Q^*} > \left. \frac{dQ}{dP} \right|_D \frac{P^*}{Q^*} \quad \text{for stability with downward sloping supply and demand.}$$

That is, stability requires that the elasticity of supply exceed the elasticity of demand at price P^* . But by equations (2), the elasticity of supply equals -1. Therefore stability requires that the elasticity of demand at price P^* be algebraically smaller than -1.

Q.E.D.

Theorem 2

An increase in the number of physicians in a market in a state of stable equilibrium must lead to a decrease in the price of physicians' services and an increase in expenditure upon physicians' services.

Proof:

Let (P_0, Q_0) represent the original equilibrium price and quantity. Let T_0 represent the aggregate target levels of revenue of the original physicians in the market. Since (P_0, Q_0) represents a point on the supply curve, it must be true that $P_0 Q_0 = T_0$.

Let t represent the aggregate target of the new physicians entering the market. Then the new equilibrium price and quantity (P_1, Q_1) must be such that $P_1 Q_1 = (T_0 + t)$. That is, total expenditures on physician services must increase with the increase in the number of doctors. But by theorem 1, the original equilibrium can be stable only if demand is elastic at price P_0 . Thus, total revenue can increase only if price is decreased. That is, in order that: $P_1 Q_1 > P_0 Q_0$ it is necessary that: $P_1 < P_0$.

Q.E.D.

Theorem 2 is illustrated in figure 2. An increase in the number of physicians shifts the supply curve to the right. At the original price P_0 , there would exist an excess of supply. By assumption 1, price would

fall until the new equilibrium level P_1 is reached.

The existence of an equilibrium under this market system can not be guaranteed. There may be so many physicians in a market that the supply curve does not intersect the demand curve. Clearly, in such a case, not all physicians can earn their target incomes, and, therefore, the target income model can not apply. This problem will be further considered in sections 2B and 3.

Theorem 2 implies that the target gross income (without demand shifting) model can not provide an explanation of anomalous empirical results. Qualitatively, the target model predicts the same effect upon price of an increase in the number of physicians as that predicted by a standard supply-demand model. Quantitatively, however, the downward sloping supply curve of the target model implies an even greater reduction in price in response to increased physician supply.¹⁰ The analysis will therefore turn to a model which employs the alternative definition of "income."

Suppose that the economic decisions of each physician are made with the purpose of earning a target level of net income or profit. Let T_i^* represent the i^{th} physician's target level of profit, and let $C_i(q_i)$ represent the cost which must be incurred by the i^{th} physician to supply the level of services q_i . Then the supply schedule of the i^{th} physician represents all those price-quantity pairs which satisfy the condition that $P_i q_i - C_i(q_i) = T_i^*$. That is:

$$(4) \quad P_i = \frac{T_i^*}{q_i} + \frac{C_i(q_i)}{q_i}$$

Equation (4) indicates that the inverse supply function for the i^{th} physician may be derived graphically as the sum of average cost $C_i(q_i)/q_i$

plus average profit (T_1^*/q_1). This technique is illustrated in figure 3.

The slope of the inverse supply function may be determined by differentiating equation (4) with respect to output.

$$(5) \quad \frac{\partial P_1}{\partial q_1} = - \frac{T_1^*}{q_1^2} + \frac{\partial [C_1(q_1)/q_1]}{\partial q_1}$$

Expression (5) may be rewritten by performing the differentiation on the right hand side of that equation and substituting equation (4).

$$(6) \quad \frac{\partial P_1}{\partial q_1} = \frac{1}{q_1} [C_1'(q_1) - P_1]$$

By equation (5), a physician's inverse supply function can be expected to have negative slope at small levels of output, if there exist any fixed costs or economies of scale. Furthermore, the inverse supply function is negatively sloped at every level of output if average cost is a nonincreasing function of output.

In cases in which diseconomies of scale result in a positive sloping segment of the inverse supply function, ambiguities arise, since quantity supplied is not a single valued function of price. In such cases, derivation of the physician's supply function requires further assumptions concerning which price, quantity pair the physician would choose.

The physician's elasticity of supply at any chosen price-quantity pair may be derived by differentiating equation (4):

$$(7) \quad \frac{dq_1}{dP_1} \frac{P_1}{q_1} = - \frac{P_1}{P_1 - C_1'(q_1)}$$

Equations (6) and (7) together imply that the elasticity of supply must be algebraically smaller than -1 at every price-quantity pair at which

the inverse supply function has negative slope. That is:

$$(8) \quad \left. \frac{dq_i}{dp} \right|_S \frac{p_i}{q_i} < -1 \quad \text{for} \quad \left. \frac{dp_i}{dq_i} \right|_S < 0$$

An aggregate supply function can be derived without further assumption if all physicians' inverse supply functions are downward sloping. In this case, a result analogous to Theorem 2 can be derived.

Theorem 3

Assume that either: (a) average cost is a nonincreasing function of output for every physician, or (b) no physician chooses to supply a quantity of services so large that marginal cost exceeds price. Then an increase in the number of physicians in a market currently in stable equilibrium will lead to a decrease in equilibrium price and an increase in expenditures upon medical services.

Proof:

Given condition (a) or (b), each physician chooses only price quantity pairs along a negatively sloped segment of his inverse supply. By equation (8), this implies that each physician's elasticity of supply is algebraically smaller than -1. Since the elasticity of aggregate supply is equal to a weighted average of the individual elasticities, aggregate elasticity of supply must be less than -1. Therefore, stability requires that the elasticity of demand at equilibrium be algebraically smaller than -1. Thus a rightward shift of the supply curve must result in a decreased equilibrium price and an increase in expenditures.

Q.E.D.

If some physicians have upward sloping supply functions, then an increase in the number of physicians will not necessarily lead to an increase in expenditures. However, price must decrease.

Theorem 4

An increase in the number of physicians in a market in a state of stable equilibrium must lead to a decrease in the price of physician services.

Proof:

Equilibrium in any supply and demand system may be represented as the solution to the following equations.

$$Q^d = D(P)$$

$$Q^s = S(P, y)$$

$$Q^d = Q^s$$

where y represents an exogeneous supply shifting factor. Let subscripts denote differentiation. Assume by definition that $S_y > 0$. The effect upon equilibrium price of an increase in supply may be calculated as follows:

$$(9) \quad \frac{dP}{dy} = \frac{-S_y}{S_p - D_p}$$

Consider first the case that enough physicians have downward sloping supply curves that the aggregate supply has negative slope. In this case, equation (3) implies that the equilibrium can be stable only if $S_p - D_p > 0$. But then by equation (9), $dP/dY < 0$. Next consider the case that the aggregate supply curve has positive slope. In this case it must be true that $S_p - D_p > 0$. Therefore $dP/dY < 0$.

Q.E.D.

Theorems 3 and 4 indicate that the predictions of the net income target model are not seriously different from the predictions of the gross income target model. One may conclude, therefore, that target income behavior by itself will not lead to anomalous relationships between price

and supply.

2B. Implications of the Target Income Hypothesis with Demand Inducement

The analysis of the implications of demand inducement will be performed first under the assumption that demand can be shifted without limit, and then under a more realistic assumption that demand can be shifted only within a limited range.

Suppose that doctors can shift consumer demands without limit. That is, by giving advice, doctors may shift the market demand function so that it passes through any desired point in quantity-price space. In this case, the concept of consumer demand is almost meaningless. The locus of all possible market equilibria is independent of demand and is represented simply by the market supply curve. This is true because the proper amount of "advice" can cause the demand curve to intersect any point on the supply curve.

This model makes no predictions about the level of price or the quantity of output other than that the price and quantity must yield the target levels of income to physicians. In the case that "income" is defined as gross income, equilibrium requires only that the product of price times quantity equal the aggregate of physicians' targets. For example, this model predicts that an increase in the number of physicians will lead to a proportionate increase in expenditures for physician services. However, the model is silent concerning the effect upon the level of price. This indeterminate effect upon equilibrium of an increase in supply is illustrated in figure 4.

The implications of this model for empirical analysis are quite surprising. Since consumer demand does not determine market equilibrium, only variables which affect the aggregate target income can affect equi-

librium price and quantity. Variables which can be expected to affect only consumer demand, such as population and insurance coverage, have no effect upon equilibrium, and therefore should not appear in any regression equations. Estimation of a demand function makes no sense. Furthermore, since equilibrium price and quantity are indeterminate, estimation of the supply of physicians would be accomplished most efficiently with the choice of income as the dependent variable.

These drastic implications may be questioned because of the extreme assumption of unlimited demand shifting potential of this model. Certainly it seems unlikely that each consumer could be induced to spend more than his expected lifetime earnings on physicians' services. The possible implications of limits to the extent to which demand can be shifted therefore should be investigated.

Suppose doctors can shift demand only within a limited range. It seems reasonable to represent consumer demand in this case by two demand functions; namely, a minimum demand, which represents quantity demanded at each price when doctors discourage demand to the maximum extent, and a maximum demand, which represents quantity demanded at each price when doctors encourage demand to the maximum extent. It is assumed that demand may be shifted so as to pass through any point that lies between these two extreme demand curves. A possible pair of maximum and minimum demands are illustrated in figure 5. The entire range of demand is represented by the shaded area between the two curves.

Possible market equilibria consist of all points at which supply and demand can be equated. The locus of these points is represented by those portions of the supply curve that lie within the feasible range of demand. Such an equilibrium locus is illustrated in figure 6.

The set of potential equilibrium quantity-price pairs in this model is simply a subset of the set of equilibrium points of the previous model (in which potential demand shifting was unlimited). Therefore, the predictions of this model, in general, are the same as the predictions of the previous model. A few additional predictions may be derived in the special cases in which the constraints upon demand are binding. Specifically, if the market is currently in equilibrium at a price-quantity pair located at the intersection of the minimum demand curve with the supply curve, then an exogenous increase in demand or decrease in physician supply must result in a price change. Similarly, if the market is currently in equilibrium at a price-quantity pair located at the intersection of the maximum demand curve with the supply curve, then an exogenous decrease in demand or increase in supply must result in a price change. Both these situations correspond directly to supply and demand equilibria in the case of no demand inducement. Therefore the effects of these exogenous shifts must be the same as those considered in section 2A. That is, in these two exceptional cases, a change in supply or demand will result in qualitatively the same effect as those predicted by a standard supply and demand model.

As in the case of unlimited demand shifting, the limited supply-induced demand model predicts that exogenous changes in variables which affect only consumer demand generally have no effect upon expenditures for medical services. Total expenditures depend only upon the aggregate level of physicians' targets. Thus, empirical estimation of a demand function when demand inducing behavior is suspected is meaningless. Furthermore, (with the exception of the two cases mentioned), a demand inducing model can make no predictions concerning the response of price to changes in supply or demand variables.

As in the case of the target income behavior without demand inducement, existence of a market equilibrium can not be guaranteed if potential demand inducement is bounded. The existence of a maximum extent to which any consumer's demand may be shifted implies the existence of a maximum level of expenditures which can be extracted from any set of consumers of medical service. This maximum is determined by the point of unit elasticity on the maximum demand curve. If the aggregate level of target incomes is so large as to require revenues greater than this maximum, clearly, the aggregate target can not be attained.

An analysis of market equilibrium in such a circumstance requires behavioral assumptions beyond those of the target income hypothesis. For the purposes of the empirical analysis of this paper, it will be assumed that, in such a case, physicians as a group do the best they can, given the circumstances. That is, it will be assumed that physicians as a group maximize aggregate income subject to the maximum demand constraint.¹¹ Thus it will be assumed that in a situation of "permanent excess supply," one price and aggregate quantity of service is agreed upon. This price and service level are independent of the aggregate supply function. This assumption implies that the equilibrium price, quantity, and level of expenditures are determined solely by the maximum demand function.

3. Specification of an Empirically Testable Model

It is the purpose of this section to propose an empirical model which is based upon the implications of the analysis of section 2. This model includes the following basic structure. Each physician, denoted by the index j , possesses a target level of income, T_j^* . For each consumer, there exists an upper limit to the amount which he is willing to spend on physicians' services. If all doctors, treated as a group, attempt to extract

revenues greater than the aggregate of all consumers' maxima, then target income levels can not be achieved. Otherwise, through appropriate demand manipulation, each physician manages to earn his target income. It is assumed that physicians' targets apply to net income, or profits. Therefore, the consumers' maximum expenditure constraint can be made operational only by specifying some correspondence between profits and revenues. For simplicity, it is assumed that the profit earned by each physician is proportional to the revenue earned by that physician. Given this assumption, the i^{th} consumer's maximum level of expenditures can be measured as the maximum number of dollars that consumer is willing to contribute to net incomes of physicians, denoted by M_i .

Let R_j represent the net income realized by the j^{th} physician in a market. Then the model predicts that:

$$(9a) \quad R_j = T_j^* \quad \text{if } \sum_j T_j^* \leq \sum_i M_i$$

If the sum of physicians' targets exceeds the aggregate expenditure maximum, it is assumed that the physicians as a group will extract that maximum expenditure, and these earnings will be divided approximately equally among all doctors. That is:

$$(9b) \quad R_j = \frac{\sum_i M_i}{J} + \theta_j \quad \text{if } \sum_j T_j^* > \sum_i M_i$$

where J equals the number of doctors in the market, and θ_j represents a random, or error term.

To further specify the model, it is assumed that the target of the j^{th} physician may be represented as the sum of a linear function of r exogenous variables, $y_{j1}, \dots, y_{jr}$, plus an error term:

$$(10) \quad T_j^* = \sum_{k=1}^r t_k y_{jk} + \varepsilon_j$$

It is further assumed that the maximum number of dollars which the i^{th} consumer is willing to contribute toward the income of physicians in that market may be represented as the sum of a linear function of s exogenous variables $x_{i1}, \dots, x_{is}$, plus an error term.

$$(11) \quad M_i = \sum_{k=1}^s m_k x_{ik} + \mu_i$$

With observations of physicians' incomes and exogenous variables in various markets, equations (10) and (11) could be estimated by OLS if one knew the markets in which the maximum expenditure constraints were binding. Of course, this latter information is not available. Therefore, these equations must be estimated by a maximum likelihood technique which simultaneously estimates equation (10), equation (11), and the probabilities that the maximum expenditure constraint is binding in each market. The details of the assumptions required for this procedure, and specification of the likelihood function, are described in Sweeney (1980).¹²

4. Empirical Results

The model represented by equations (9), (10) and (11) was estimated with data from the 1975 N.O.R.C. Physician Practice Cost Survey. These data include measures of income and various characteristics of 877 physicians in 30 SMSA's (or counties) throughout the U.S. (see Sloan, et al. (1978a) for a thorough description of this data set). Each SMSA was assumed to represent a separate market for physicians' services. These markets ranged in size from a population of 7,000 (Morris County, Ka.), to a population of 9,885,000 (New York). The physicians surveyed included pediatricians, general surgeons, general/family practitioners, internists, and obstetricians/gynecologists.

The results of the estimation are summarized in Table 1. Three separate sets of estimates are reported. Model 1 assumes that both a physician's target and the maximum which any consumer is willing to spend are totally independent of exogenous variables. That is, both targets and maxima are purely random numbers. Model 2 assumes that the target of each physician depends upon the number of years of post medical school training required for his specialty, the average income level of the community in which he works, the number of children which he has, and whether the physician is affiliated with a medical school. The maximum expenditure level of a consumer is assumed to depend upon that consumer's income level, the number of children in the consumer's family, insurance coverage, and race.¹³ Model 3 is a simplified version of model 2, which includes only those variables of model 2 which have coefficients significantly different from zero at the 90% confidence level.

Detailed descriptions of the variables are presented in appendix I. The variables are scaled so that the target level of income is measured in thousands of dollars, and the maximum contribution per consumer toward physicians' incomes is measured in dollars. All financial variables were deflated by a local cost of living index.

The estimates of model 1 suggest an average target level of income of approximately \$70,000. Since the average level of realized income in the sample equaled \$55,077, it is apparent that some physicians goals must have been frustrated. Consumers could be expected on average to balk at contributing more than \$49.60 to the annual income of physicians in the 5 specialty classes.¹⁴

The parameter estimates of model 2 suggest that a physician's target level of income: (i) increases by \$10,000 for each additional year spent in post medical school training, (ii) increases by \$15,600 per \$1,000 increase in the average income level of the community, and (ignoring significance tests), (iii) increases by \$3,000 per child in his family, and (iv) is

\$12,600 smaller for physicians who are affiliated with a medical school faculty. Note that one can not with reasonable confidence reject the hypotheses that number of children and faculty affiliation have no effects upon the target. The maximum per capita amount consumers are willing to contribute to the profit of doctors of the 5 specialties: (i) increases by \$14.6 per \$1,000 of per capita income, (ii) decreases by \$4.5 per 1% of the population composed of children, and (ignoring significance levels) (iii) decreases by \$.4 per 1% increase in the portion of the population without medical insurance, (iv) increases \$.3 per 1% increase in the portion of the population who are minorities, and (v) is not affected by the fraction of the population composed of senior citizens. One cannot with reasonable confidence reject the hypotheses that percent without insurance, percent minority, and percent senior citizens have no effects upon the maximum per capita expenditure level.

Employing the coefficients and variance estimates, one may derive the probability that the aggregate of the targets in one market will exceed the aggregate of the expenditure maxima of consumers in that market. These estimates are presented in Table 2.

Under the assumptions of model 1, the probability that the aggregate of targets exceeds the aggregate of expenditure maxima in any market depends only upon the population and number of physicians in that market.¹⁵ Given the parameter estimates of that model, the probability that the aggregate of targets exceeds the aggregate of maxima must be greater than 1/2 in any market that has more than one physician per 1409.3 consumers, (or, equivalently, more than 71 physicians per 100,000 population). Under the assumptions of models 2 and 3, the probability that the sum of targets exceeds the aggregate maximum expenditure level depends also upon the values of the exogenous variables.

The probabilities in Table 2 give rough estimates of the likelihood that physicians in a market can achieve their targets. In this sense, the estimates provide an indication of the applicability of the "target income with demand shifting" model. It is interesting to note that under the random model, the probability that physicians can achieve their targets exceeds .5 in only 9 of the 30 markets.¹⁶ This number drops to 8 under model 2 and 6 under model 3. As should be expected, physicians are most likely able to achieve their targets in the small, rural markets. In the large urban areas of New York, Los Angeles, San Diego, Chicago, and New Orleans, the probability that target income pricing prevails is minute.

Summary and Conclusions

Without an accompanying assumption of demand inducement, a target income model yields qualitatively the same predictions as those of a standard supply and demand model. An increase in the supply of physicians or a decrease in the demand for their services leads to a lower equilibrium price. Furthermore, if the target pertains to gross income, stable market equilibria can occur only at price levels at which demand is elastic. Therefore, the decrease in price which results from increased supply must be accompanied by increased total expenditure upon physicians' services.

A target income model with an assumption of demand inducement yields surprisingly few predictions. Indeed, enumeration of phenomena which can not be predicted by such a model should be of greater interest to those involved in the current debate about the nature of the physicians' market. Specifically, neither the price level nor its direction of change can be predicted. There can exist no systematic relationship between price and any exogenous variables. If demand inducing behavior is hypothesized, the empirical estimation of any function assumed to represent demand is a

meaningless exercise. Furthermore, unless consumers' willingness to pay for physicians' services is unbounded, the feasibility of target seeking behavior must be limited. Thus, any empirical estimation of market characteristics must account for this limited applicability.

The empirical estimates of the determinants of a physician's target level of income and determinants of maximum expenditure ceilings of consumers presented here imply that, for physicians in the five specialties, target seeking behavior is likely to be feasible only in small, rural markets. Stated alternatively, these estimates imply that any potential for demand inducement have most likely been exhausted in all but the smallest markets of the sample.

FOOTNOTES

¹The statistics in this paragraph were obtained from: U.S. Bureau of the Census (1978).

²Fuchs, V., Kramer M. (1972) p. 2.

³Newhouse, J. (1970) p. 181.

⁴Evans, M. (1974) n. 30, p. 168.

⁵Fuchs, V. (1976) p. 54.

⁶For an excellent survey, see Sloan-Feldman (1978).

⁷Neither of these authors suggested demand inducement as an explanation for their findings.

⁸See for example, Baumol (1959).

⁹For the purpose of this analysis, it is assumed that a physician's service is a commodity which can be quantified by a scalar measure.

¹⁰Let p_s represent the slope of the inverse supply curve (measured at the equilibrium price), and let p_d represent the slope of the inverse demand. Then the effect upon equilibrium price of a rightward shift of supply (or leftward shift of demand) is proportional to $1/[1/p_d - 1/p_s]$. Thus, the smaller (more negative) the p_s , the more negative is the effect upon equilibrium price.

¹¹An alternative hypothesis might be that physicians, attempting to maximize their own profits, compete. The alternative in the text was chosen because it appears (to the author) to more closely fit the spirit of the supply induced demand hypothesis.

¹²The following distributions are assumed:

$$\begin{array}{ll} \theta_j \sim n(0, \sigma_\theta^2) & \psi_j \\ \varepsilon_j \sim n(0, \sigma_\varepsilon^2) & \psi_j \\ \mu_i \sim n(0, \sigma_\mu^2) & \psi_i \end{array}$$

These distributions are assumed to be the same in each market.

Furthermore, it is assumed that the group of physicians from any one market included in the data set compose a representative sample of all physicians in that market. That is, in any one market, the sample average (over physicians from that market) of the vector of exogenous variables ($y_{1j}, \dots, y_{rj}$) is assumed to equal the population (of physicians in that market) average.

Let N represent the number of separate markets included in the data set. Let n_k and d_k respectively represent population and number of doctors in market k . Let w_k represent the number of physicians from the k^{th} market included in the sample. The likelihood function has the following general form:

$$L = \prod_{k=1}^N G_k$$

where G_k is the sum of two products:

$$G_k = + \left[\begin{array}{l} \text{probability of observing the } w_k \text{ incomes given that} \\ \sum_{j=1}^{d_k} T_{kj}^* \leq \sum_{i=1}^{n_k} M_{ki} \end{array} \right] \\ \times \left[\begin{array}{l} \text{probability that } \sum_{j=1}^{d_k} T_{kj}^* \leq \sum_{i=1}^{n_k} M_{ki} \end{array} \right] \\ + \left[\begin{array}{l} \text{probability of observing the } w_k \text{ incomes given that} \\ \sum_{j=1}^{d_k} T_{kj}^* > \sum_{i=1}^{n_k} M_{ki} \end{array} \right] \\ \times \left[\begin{array}{l} \text{probability that } \sum_{j=1}^{d_k} T_{kj}^* > \sum_{i=1}^{n_k} M_{ki} \end{array} \right]$$

where the additional subscript k on T^* and M denotes the market.

¹³ Since each consumer is assumed to have an expenditure maximum which is linear in the exogenous variables, the sum of all consumers' maxima can be calculated as a function of the average level of exogenous variables in each community. That is, because of the assumed functional form, data about each individual consumer is unnecessary. Rather, the model can be estimated with measures of the average level of each exogenous variable in the community (and population).

¹⁴ The data also included estimates of gross income, or revenue, received by each physician. Although the accuracy of these individual estimates are subject to doubt, the average of these figures can probably provide a useful estimate of the relationship between physicians' incomes

and expenditure by consumers. Specifically, the average ratio of estimated gross income divided by net income over all physicians equals 1.62. Applying this number to the coefficient 49.60 in model 1 suggests that the average maximum amount which a consumer is willing to spend for services from the five specialties equals \$80.35.

¹⁵Specifically, let t and m represent the coefficients of the target and maximum equations, respectively. Let ϕ_k represent the population physician ratio in market k . Then:

$$\Pr \left[\sum_{j=1}^{d_k} T_j^* > \sum_{i=1}^{n_k} M_i \right] = 1 - F_{\text{std}} \left[\frac{\sqrt{d_k} m_0 (\phi_k - t_0 / m_0)}{(\phi_k \sigma_\mu^2 + \sigma_\epsilon^2)^{\frac{1}{2}}} \right]$$

where $F_{\text{std}}(\cdot)$ denotes the value of the cumulative standard normal distribution function.

¹⁶The probability that physicians will achieve their targets equals 1 minus the probability that the aggregate of the targets exceeds the aggregate maximum.

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Appendix I

Description of Exogenous Variables

All variables are obtained from the 1975 N.O.R.C. Physician Practice Cost Survey, (ABT Master File and Area Resource File), except where otherwise specified.

No. yrs. training: number of years post medical school training required for specialty:

pediatrics	= 3
obstetrics & gynecology	= 4
general surgery	= 4.5
general/family practice	= 0
internal medicine	= 3

(source: Directory of Medical specialties, 18th ed., Chicago: Marquis)

Community per capita income: per capita income of SMSA, adjusted by local cost of living index for intermediate family of four. (Cost of living index source: BLS Handbook of Labor Statistics, 1975,)

No. of children in family: number of children in physician's family

faculty affiliation: equal to 1 if physician is a member of a medical school faculty, 0 otherwise.

income: same as "community per capita income"

% under 15: percentage of population aged 14 and under.

% without insurance: percentage of population with no insurance, adjusted for specialty mix.

% minority: percentage of population which is Black or Hispanic

% over 64: percentage of population aged 65 and older.

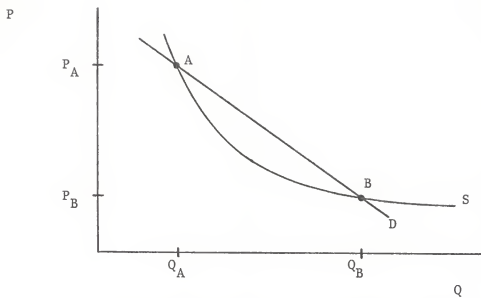
Table 1

Parameter Estimates and T Statistics

	Model 1	Model 2	Model 3
PHYSICIAN'S TARGET INCOME [equation (10)]			
constant	69.96 (22.48)	-42.76 (-1.63)	-31.82 (-1.22)
no. yrs. training		10.00 (2.95)	8.30 (2.77)
community per capita income		15.64 (3.14)	15.50 (2.97)
no. of children in family		2.89 (0.83)	
faculty affiliation		-12.58 (-0.91)	
CONSUMERS' MAXIMUM PER CAPITA CONTRIBUTION TO INCOME [equation (11)]			
constant	49.64 (22.18)	100.05 (1.79)	89.23 (3.71)
income		14.55 (3.52)	14.57 (4.00)
% under 15		-4.47 (-3.05)	-4.08 (-3.76)
% without insurance		-0.42 (-0.89)	
% minority		0.27 (1.02)	
% over 65		0.03 (0.01)	
Log (Likelihood):	-4218.58	-4202.53	-4204.06

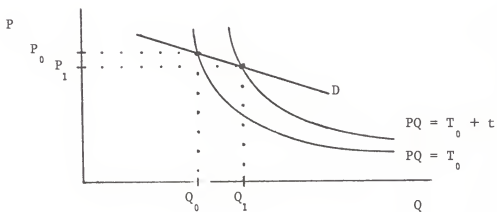
Table 2

SMSA	Population (thousands)	Population No. Physicians	Pr j	ΣT_j^*	$> \Sigma M_i$
			#1	#2	#3
Birmingham, Al.	749	1,140	.78	.78	.87
Fresno, Cal.	439	1,202	.66	.89	.80
Los Angeles	6,944	884	1.00	1.00	1.00
San Diego	1,501	949	.99	1.00	.97
Mesa, Co.	19	339	.94	.97	.95
New Britain, Ct.	943	1,116	.83	.95	.87
Springfield, Ma.	605	1,276	.62	.91	.72
Orlando, Fa.	572	1,303	.59	.88	.68
Atlanta	1,733	1,186	.82	.99	.95
Chicago	7,090	1,236	.92	1.00	1.00
St. Louis	2,382	1,363	.58	.87	.85
Morris Co., Ka.	7	2,333	.45	.41	.35
Topeka, Ka.	194	1,426	.49	.59	.51
New Orleans	1,092	1,068	.89	1.00	1.00
Flint, Mi.	524	1,851	.26	.90	.79
Detroit	4,469	1,471	.37	1.00	.98
Carroll, Mo.	12	3,000	.41	.24	.27
Great Falls, Mont.	85	1,012	.66	.84	.73
Newark	2,080	1,048	.97	.99	.99
New York	9,885	944	1.00	.85	.91
Johnston Co., N.C.	64	2,560	.34	.35	.28
Wilkes, N.C.	54	3,600	.30	.28	.28
Columbus, Oh.	1,070	1,391	.52	.68	.63
Armstrong Co., Pa.	75	2,885	.30	.28	.24
Reading, Pa.	304	1,165	.67	.51	.34
Philadelphia	4,834	1,165	.96	.76	.89
Florence, S.C.	92	1,179	.59	.75	.75
Wichita Falls, Tx.	128	1,255	.57	.53	.45
Chittenden Co., Vt.	107	748	.86	1.00	.97
Marion, W. Va.	64	1,524	.47	.33	.27



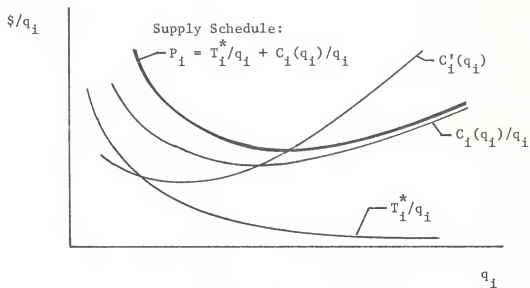
Supply and Demand without Demand Inducement
Gross Income Target

Figure 1



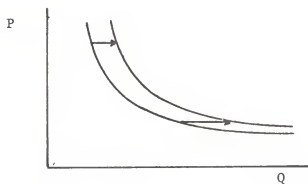
Effect of an Increase in Supply of Physicians

Figure 2



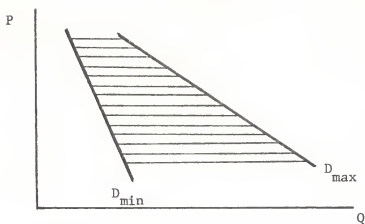
Derivation of Physician's Supply Schedule
Net Income Target

Figure 3



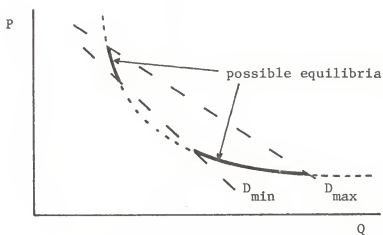
Effect upon Equilibria of an Increase in
Supply of Physicians

Figure 4



Feasible Region of Demand with Limited Inducement

Figure 5



Equilibria with Target Income
and Limited Demand Inducement

Figure 6

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